WHAT IS CLAIMED IS:

1. A lithographic apparatus comprising:

a radiation system for providing a beam of radiation;

a patterning device to impart a desired pattern onto said beam of radiation along its cross-section;

a substrate holder for holding a substrate;

a projection system for projecting said patterned beam of radiation onto a target portion of said substrate; and

a substrate alignment system for detecting a position of said substrate relative to a position of said patterning device, said substrate alignment system comprising:

a source configured to generate an incoming optical beam,

at least one grating, provided on said substrate, having a diffraction length, said at least one grating configured to generate at least one diffraction order of constituent diffracted beams based on an interaction with said incoming optical beam over said diffracting length, and

an optical device configured to image said at least one diffracted order on a sensor device,

wherein said optical device includes an aperture at a predetermined location to allow said constituent diffracted beams to pass through, and

wherein said optical device is arranged to broaden said constituent diffracted beams such that a beam diameter of said constituent diffracted beams is larger than a diameter of said aperture.

2. The lithographic apparatus of Claim 1, wherein said optical device comprises mechanism for generating a reduced incoming optical beam based on said incoming optical beam, said reduced incoming optical beam having a reduced beam size which illuminates a portion of said grating.

3. The lithographic apparatus of Claim 2, wherein said beam size of said reduced incoming optical beam is smaller than said portion of said grating.

4. The lithographic apparatus of Claim 3 wherein said optical device is configured to have a position error less than 2.0 μm/degree of tilt.

5. The lithographic apparatus of Claim 3, wherein said optical device is configured to have a position error less than 400 nm/degree of tilt.

6. The lithographic apparatus of Claim 1, wherein said optical device comprises a first type of said at least one grating having a first diffracting length substantially smaller than said beam size of said incoming optical beam.

7. The lithographic apparatus of Claim 6, wherein said optical device further comprises a second type of said at least one grating having a second diffracting length being substantially larger than said first diffracting length.

8. The lithographic apparatus of Claim 7, wherein said optical device is configured to have a position error less than 2.0 μm/degree of tilt.

9. The lithographic apparatus of Claim 7, wherein said optical device is configured to have a position error less than 400 nm/degree of tilt.

10. A substrate alignment method, comprising:

configuring a beam of radiation with a desired pattern in its cross-section based on a patterning device;

providing a substrate; and

detecting a position of said substrate relative to a position of said patterning device by:

generating an incoming optical beam,

providing at least one grating, on said substrate, having a diffracting length, said at least one grating generating at least one diffraction order of

constituent diffracted beams based on an interaction with said incoming optical beam over said diffracting length,

imaging said at least one diffraction order on a sensor device,

positioning an aperture at a predetermined location to allow said constituent diffracted beams to pass through, and

broadening said constituent diffracted beams such that a beam diameter of said constituent diffracted beams is larger than a diameter of said aperture.

11. The substrate alignment method of Claim 10, further including:

measuring a first shift of an image of said at least one diffraction order generated on said at least one grating of a first type as a function of a tilt applied to said at least one grating of said first type;

measuring a second shift of an image of said at least one diffraction order generated on said at least one grating of a second type as a function of a tilt applied to said at least one grating of said second type;

determining from said first shift and said second shift a value of a defocus of said at least one gratings of said first type and said second type; and

determining from said value of said defocus a value of an Abbe arm, said Abbe arm being a distance between a surface comprising said at least one grating of said first and second type and a position of a pivot for said tilt.

12. The substrate alignment method of Claim 11, further including:

generating said first shift of said image of said at least one diffraction order by a first incoming beam on said at least one grating as a function of a tilt applied to said at least one grating, and

generating said second shift of said image of said at least one diffraction order by a second incoming beam on said at least one grating as a function of a tilt applied to said at least one grating,

wherein said second incoming beam is configured to have a different diameter than said first incoming beam.

13. The substrate alignment method of Claim 11, further including:

generating said first shift of said image of said at least one diffraction order on said at least one grating of a first type as a function of a tilt applied to said at least one grating of said first type;

generating said second shift of said image of said at least one diffraction order on said at least one grating of a second type as a function of a tilt applied to said at least one grating of said second type;

wherein said at least one grating of said first type is configured with a first diffracting length that is substantially smaller than said beam size of said incoming optical beam, and

wherein said at least one grating of said second type is configured with a second diffracting length that is substantially larger than said first diffracting length.

14. A device manufacturing method comprising:

providing a beam of radiation;

configuring said beam of radiation with a desired pattern in its cross-section based on a patterning device;

providing a substrate;

projecting the patterned beam of radiation onto a target portion of said substrate; and

detecting a position of said substrate relative to a position of said patterning device by:

generating an incoming optical beam,

providing at least one grating, on said substrate, having a diffracting length, said at least one grating generating at least one diffraction order of constituent diffracted beams based on an interaction with said incoming optical beam over said diffracting length,

imaging said at least one diffraction order on a sensor device,

positioning an aperture at a predetermined location to allow said constituent diffracted beams to pass through, and

broadening said constituent diffracted beams such that a beam diameter of said constituent diffracted beams is larger than a diameter of said aperture.

15. The device manufacturing method of Claim 14, further including:

measuring a first shift of an image of said at least one diffraction order generated on said at least one grating of a first type as a function of a tilt applied to said at least one grating of said first type;

measuring a second shift of an image of said at least one diffraction order generated on said at least one grating of a second type as a function of a tilt applied to said at least one grating of said second type;

determining from said first shift and said second shift a value of a defocus of said at least one gratings of said first type and said second type; and

determining from said value of said defocus a value of an Abbe arm, said Abbe arm being a distance between a surface comprising said at least one grating of said first and second type and a position of a pivot for said tilt.

16. The device manufacturing method of Claim 15, further including:

generating said first shift of said image of said at least one diffraction order by a first incoming beam on said at least one grating as a function of a tilt applied to said at least one grating, and

generating said second shift of said image of said at least one diffraction order by a second incoming beam on said at least one grating as a function of a tilt applied to said at least one grating,

wherein said second incoming beam is configured to have a different diameter than said first incoming beam.

17. The device manufacturing method of Claim 14, further including:

generating said first shift of said image of said at least one diffraction order on said at least one grating of a first type as a function of a tilt applied to said at least one grating of said first type;

generating said second shift of said image of said at least one diffraction order on said at least one grating of a second type as a function of a tilt applied to said at least one grating of said second type;

wherein said at least one grating of said first type is configured with a first diffracting length that is substantially smaller than said beam size of said incoming optical beam, and

wherein said at least one grating of said second type is configured with a second diffracting length that is substantially larger than said first diffracting length.

18. A lithographic alignment system for detecting a position of a substrate relative to a position of a patterning device, comprising:

a source configured to generate an incoming optical beam,

at least one grating, provided on said substrate, having a diffracting length, said at least one grating configured to generate at least one diffraction order of constituent diffracted beams based on an interaction with said incoming optical beam over said diffracting length, and

an optical device configured to image said at least one diffraction order on a sensor device,

wherein said optical device includes an aperture at a predetermined location to allow said constituent diffracted beams to pass through, and

wherein said optical device is arranged to broaden said constituent diffracted beams such that a beam diameter of said constituent diffracted beams is larger than a diameter of said aperture.

19. The lithographic alignment system of Claim 18, wherein said optical device comprises mechanism for generating a reduced incoming optical beam based on said incoming optical beam, said reduced incoming optical beam having a reduced beam size which illuminates a portion of said grating.

20. The lithographic alignment system of Claim 19, wherein said beam size of said reduced incoming optical beam is smaller than said portion of said grating.

21. The lithographic alignment system of Claim of Claim 20, wherein said optical device is configured to have a position error less than 2.0 μm/degree of tilt.

22. The lithographic alignment system of Claim of Claim 20, wherein said optical device is configured to have a position error less than 400 nm/degree of tilt.

23. The lithographic alignment system of Claim 18, wherein said optical device comprises a first type of said at least one grating having a first diffracting length substantially smaller than said beam size of said incoming optical beam.

24. The lithographic alignment system of Claim 23, wherein said optical device further comprises a second type of said at least one grating having a second diffracting length being substantially larger than said first diffracting length.

25. The lithographic alignment system of Claim 24, wherein said optical device is configured to have a position error less than 2.0 μm/degree of tilt.

26. The lithographic alignment system of Claim 24, wherein said optical device is configured to have a position error less than 400 nm/degree of tilt.